University of Suffolk

School of Engineering Arts, Science and Technology

**Module: Deep Learning Techniques and Tools**

Module Tutor: Dr Mohamed Hisham Jaward

Assessments: Assessment: Technical Report

on or before 12 noon 7th June Via Brightspace portal

Word count: 5000

**RATIONALE**

A sufficiency of inexpensive computing power, sufficiently large datasets and a number of key theoretical advances created deep learning techniques which have facilitated a wave of accuracy increases across many computational tasks (computer vision, natural language processing, speech recognition, autonomous driving, etc.), making many applications practical. Deep learning is central to modern artificial intelligence. This module explains the underlying mathematics and techniques and how to use them to achieve similar feats of computational accuracy.

**AIMS**

Through the completion of this module students will:

1. Gain an in-depth understanding of deep learning techniques.
2. Gain an in-depth understanding and ability to select, configure and deploy appropriate deep learning techniques and tools for specific scenarios.
3. Be able to derive insights from the use of deep learning and articulate uncertainties and limitations on those insights.

**LEARNING OUTCOMES**

On successful completion of this module, a student will be able to:

1. Evaluate the technical dimensions of architectures and solutions utilising deep learning
2. Demonstrate deep knowledge and systematic understanding of theory, techniques and applications of deep learning as informed by research and practice at forefront of the discipline
3. Combine theory, research and practice at forefront of the discipline and use it to guide the design and implementation of robust deep learning solutions
4. Demonstrate competency in assessing, understanding, creating and improving deep learning solutions and using these to analyse data sets to generate insights
5. Communicate solutions and insights to technical and non-technical audiences

**Assessment: Technical Report Overview**

The students are expected to write a comprehensive technical report in order to pass this module. The student must choose a dataset, discuss and get approval from the module leader. The dataset must be large enough to suit deep learning applications such as image datasets or time-series data such as Forex/Stock price predictions. The objective of the technical report is to explore a dataset, define research questions based on a research/business requirement and complete the analysis or model building using deep learning techniques. Students can also apply machine learning methods (**but your main methodology should be based on deep learning techniques**) to compare results or generate ensembles of methods. The flow, look and feel of the technical report should be similar to a typical research paper.

Activities include:

* selecting a data set
* exploring, pre-processing, summarising and preparing the data
* defining the problem and project requirements
* defining the experimental setup
* implementing your proposed approach using deep learning methods
* evaluating and analysing your approach
* showing statistical significance of your finding wherever suitable

Your technical report resembles to a research article and the following sections are suggested:

**Abstract (10 points)**

Overall summary of your project including background, introduction, research problem, methods, results including findings or model performance and evaluation. Not to exceed 250 words (a few words over or under is fine).

**Introduction (5 points)**

Introducing the research/technical problem that you intend to solve and an overall summary of the issue with a brief summary of the findings or solution proposed.

**Literature Review (15 points)**

A critical literature review of an area of the dataset that you selected. Use Google Scholar and dblp.org to find suitable papers published in your chosen field. The literature review should also cover the review of technical methods (machine learning and deep learning) presented in the literature. The literature review should not merely be descriptive but should be critical in nature, with a view to facilitating addressing the research proposal.

**Methods and Experimental Setup (20 points)**

Explain the source of your data and the data itself with basic statistics. Describe the deep learning methods/tool you choose to address your research question(s). This could include:

* Stating your hypotheses if suitable.
* Describing how you will quantify reliability e.g. significance testing, evaluation, classification f1-score.
* Identify datasets and the data you derived from them.
* Describe the novelty of your approach if any, 10 marks are allocated if your novelty results in an increase in your evaluation matrix (accuracy, precision or f1-score etc.). If feature engineering resulted in improved performance no extra marks are allocated, this is something expected out of you.
* Describe your proposed model and any benchmark models for comparison:
* Deep learning techniques, features, model tuning, parameter selection
* Explain how your analysis could focus on answering your research questions, operational variables for analysis, method of analysis.

**Results (40 points)**

* Summarise results, reliability and comparison to any benchmark analyses or models.
* Critically analyse results e.g. limitations of data, setup or approach, characteristic errors, subtractive feature analysis, possible improvements
* Conclude with what you have learned from this study which would improve yourself as a data scientist. Would you recommend this as a solution to your problem? Provide reasons.
* Must include a figure/plot/table which summarise all or most of the results deep/machine learning methods.
* All figures and tables must be visible in the Jupyter notebook. This DOES NOT mean that figures and tables should not on your report. All relevant results should be on the report and the marking is entirely based on the technical report.
* There should be no errors in the Jupyter notebook
* Avoid screenshots unless they are critical for the results presented.

**Discussion and Conclusion (10 marks)**

* Interesting discussion around the results
* discussion around the limitation of the study
* future direction
* Overall conclusions

The report is worth 100% of the overall mark for this module. It will be marked on the clarity and readability of the above sections. The report could have more sub-level headings under above proposed sections. The report should use line spacing of at least 1.15 and a body font size of at least 11pt.

**Use of AI and Oral Viva**

While you are free to use AI tools to improve your technical writing (for example to paraphrase a sentence or to correct your grammar), it should NOT be used to generate code and/ or text. Any misuse of AI could be easily detected as they lack coherence in the presentation. Any student suspected would be invited to an oral viva and will be asked to defend his work written on the report. Based on the outcome of this interview, students could be referred to OSAR for suspected plagiarism.

**Submission Instructions**

* All bibliographies must be formatted according to UoS Harvard style.
* Ensure that your work is submitted as a SINGLE Word document or pdf with a filename matching the pattern sXXXXXX.doc or SXXXXXX.pdf where sXXXXXX is your UoS userid. Ensure that the document is marked with your UoS userid. Your name should not appear anywhere in the files.
* Nice and tidy Python code as Jupyter (Colab) notebook should be submitted as a separate file. Follow the file name as your student id as above. Each result shown in the report should have a separate cell producing the desired outcome. You may lose marks if you fail to follow this instruction as you will not have any evidence that you produced the results using the submitted code.
* Submit to Brightspace
* Be advised that The University of Suffolk has strict rules dealing with plagiarism and the university reserves the right to call any student to a viva examination on any piece of assessed work.

## Level 7 Module Grading Criteria

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| **Level 7** | | | | | | |
| In accordance with the FHEQ, at the end of Level 7 students should have a systematic understanding of knowledge, and a critical awareness of current problems and/or new insights, much of which is at, or informed by, the forefront of their academic discipline, field of study or area of professional practice. They will be able to demonstrate originality in the application of knowledge, together with a practical understanding of how established techniques of research and enquiry are used to create and interpret knowledge in the discipline. They should have a conceptual understanding that enables them to evaluate critically current research and advanced scholarship in the discipline and to evaluate methodologies and develop critiques of them and, where appropriate, to propose new hypotheses. They will also be able to deal with complex issues both systematically and creatively, make sound judgements in the absence of complete data, and communicate their conclusions clearly to specialist and non-specialist audiences. In addition, they will be able to demonstrate self-direction and originality in tackling and solving problems, and act autonomously in planning and implementing tasks at a professional or equivalent level. | | | | | | |
|  | | **Assessment category** | | | | |
| **Coherent and detailed knowledge and understanding of the subject area, at least some of which is informed by the latest research and/or advanced scholarship within the discipline** | **Cognitive and intellectual skills** | **Application of theory to practice (for courses with a professional practice element)** | **Reading and referencing** | **Presentation, style and structure**  Work that significantly exceeds the specified word limit may be penalized |
| **Pass mark, demonstrating achievement of all associated learning outcomes** | **90%-100%** | Exemplary systematic, theoretical and conceptual understanding of knowledge at or informed by the forefront of the field of study, demonstrating highly sophisticated grasp of the subject matter | Exceptional critical evaluation and awareness of current problems, and contemporary issues and debates that draws on new insights or perspectives within the field. Work demonstrates exemplary ability to synthesise current research and advanced scholarship in an original, creative and innovative manner. | Sophisticated, systematic and innovative application of knowledge and theory to professional practice within the discipline. Flawless use of systematically selected literature to justify and express reasoned judgements and decisions in relation to complex issues and problems at a professional level | A very high level of critical engagement across a systematic and fully appropriate range of relevant and current academic, research, policy- and practice-related literature demonstrating deep and selective reading and initiative along with highly consistent accurate referencing | Exemplary presentation of work that is fluent and flawless throughout. |
| **80%-89%** | Excellent systematic, theoretical and conceptual understanding of knowledge at or informed by the forefront of the field of study and showing sophisticated depth, breadth, detail and clarity | Sophisticated critical evaluation and awareness of current problems, and contemporary issues and debates that draws on new insights or perspectives within the field. Work demonstrates a very high level of originality and creativity in the student’s approaches to synthesising current research and advanced scholarship within the subject area | An excellent level of originality and innovation in the application of knowledge and theory to professional practice within the discipline. Demonstration of excellent critical awareness and evaluation and the ability to effectively critique and employ current academic literature in making reasoned judgements and decisions in relation to complex issues and problems at a professional level | A very high level of critical engagement across an extensive range of relevant and current academic, research, policy- and practice-related literature demonstrating deep and appropriate reading and initiative along with highly consistent accurate referencing | Outstanding presentation of work that is logically and coherently structured with a strong or original central argument(s), conveyed with a high level of fluency and eloquently communicates compelling, coherent conclusions to specialist and non-specialist audiences |

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| **Level 7** | | **Coherent and detailed knowledge and understanding** | **Cognitive and intellectual skills** | **Application of theory to practice** | **Reading and referencing** | **Presentation, style and structure** |
| **Pass mark, demonstrating achievement of all associated learning outcomes** | **70% – 79%** | A high level of systematic, theoretical and conceptual understanding of knowledge at or informed by the forefront of the field of study and showing considerable depth, breadth, detail and clarity | A high level of critical evaluation and awareness of current problems, and contemporary issues and debates that draws on new insights or perspectives within the field. Work demonstrates a significant level of originality and creativity in synthesising current research and advanced scholarship within the subject area | A high level of originality and innovation in the application of knowledge and theory to professional practice within the discipline. Demonstration of excellent critical awareness and evaluation and the ability to select and use academic literature in making reasoned judgements and decisions in relation to complex issues and problems at a professional level | A high level of critical engagement across an extensive range of relevant and current literature demonstrating wide and appropriate reading and initiative along with highly consistent accurate referencing | Excellent presentation of work that is logically and coherently structured with a strong or original central argument(s), conveyed with a high level of clarity of expression and which clearly communicates valid, coherent conclusions to specialist and non-specialist audiences |
| **60% – 69%** | An effective, systematic, theoretical and conceptual understanding of knowledge mostly at or informed by the forefront of the field of study and showing good depth, breadth, detail and clarity | An effective level of critical evaluation and awareness of current problems and contemporary issues and debates that draws on new insights or perspectives within the field. Work demonstrates some effective originality and creativity in synthesising current research and scholarship within the subject area | A good level of originality and innovation in the application of knowledge and theory to professional practice. Demonstration of consistently good critical awareness and evaluation and reasonable ability to use the academic literature in making reasoned judgements and decisions in relation to complex issues and problems at a professional level | A good level of critical engagement across a good range of relevant and current academic, research, policy- and practice-related literature demonstrating appropriate reading and some initiative along with consistent accurate referencing | High quality presentation of work that is largely logically and coherently structured with a generally strong central argument conveyed with a clarity of expression and which communicates clear conclusions to specialist and non-specialist audiences |
| **50% – 59%** | A sufficient but limited level of systematic, theoretical and conceptual understanding of knowledge at times at or informed by the forefront of the field of study but showing adequate depth, breadth, detail and clarity | A sufficient but limited level of critical evaluation and awareness of current problems and contemporary issues and debates, with some reference to new insights or perspectives within the field. Limited evidence of originality and creativity in synthesising current research and scholarship within the subject area | A reasonable but limited level of originality and innovation in the application of knowledge and theory to professional practice within the discipline. Demonstration of some good critical awareness and evaluation and some ability to use the academic literature in developing judgements and decisions in relation to complex issues and problems at a professional level | Sufficient critical engagement with a reasonable range of relevant and current academic, research, policy- and practice-related literature demonstrating mainly appropriate reading but limited initiative and/or some minor inconsistencies and inaccuracies in referencing | Generally good presentation of work that is sufficiently logical and coherent in structure with a discernible central argument. May present limited originality and lack some clarity of expression, but an identifiable conclusion reasonably communicated to specialist and non-specialist audiences |

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| **Level 7** | | **Coherent and detailed knowledge and understanding** | **Cognitive and intellectual skills** | **Application of theory to practice** | **Reading and referencing** | **Presentation, style and structure** |
| **Marginal fail** | **45% – 49%** | Knowledge and understanding of the subject matter is incomplete, uninformed or limited in its scholarship within the field of study, or lacking sufficient depth, breadth, detail or clarity | Critical evaluation is limited or lacks awareness of current problems and contemporary issues and debates. Insufficient reference made to new insights or perspectives within the field, or insufficient evidence of originality and creativity in synthesising current research and scholarship within the subject area | Insufficient degree of originality or innovation in the application of knowledge and theory to professional practice within the discipline. Demonstration of poor critical awareness and evaluation or a lack of ability to use the academic literature in developing judgements and decisions in relation to complex issues and problems at a professional level | Insufficient critical engagement with relevant and current academic, research, policy- and practice-related literature. Lack of evidence of wider reading or a lack of initiative or inconsistent and inaccurate referencing | Presentation of work shows insufficient organisation or central argument, and is lacking in logical and coherent structure. Poor clarity of expression weakly communicating to specialist or non-specialist audiences |
| **Fail** | **30% – 44%** | Limited knowledge and understanding of the subject matter shown. Work is not sufficiently informed by scholarship within the field of study and is insufficient in depth, breadth, detail or clarity | Insufficient evidence of critical evaluation and awareness of current problems and contemporary issues and debates. Insufficient reference to new insights or perspectives within the field and lacking in originality and creativity in synthesising current research and scholarship within the subject area | Little evidence of originality and innovation and a significant lack of application of knowledge and theory to professional practice demonstrating little critical awareness and evaluation and a lack of ability to use the academic literature to make judgements and decisions in relation to complex issues and problems at a professional level | Little evidence of critical engagement with relevant and current literature. Poor use of appropriate sources and/or inconsistent and inaccurate referencing | Often poorly presented work that is disorganised, has an ill-formed central argument, and lacks a logical and coherent structure. A lack of clarity of expression or fails to communicate effective conclusions to specialist or non-specialist audiences |
| **< 30%** | Inadequate and limited knowledge and understanding of the subject matter shown. Work is not informed by scholarship within the field of study and significantly lacks depth, breadth, detail or clarity | Descriptive work with little or no evidence of critical evaluation and awareness of current problems and contemporary issues and debates. No evidence of awareness of new insights or perspectives within the field. Little or no synthesis of current research and scholarship within the subject area | No evidence of originality and innovation and little to no application of knowledge and theory to professional practice. Demonstrates no critical awareness and evaluation and a distinct lack of ability to use the academic literature in an effective manner | No evidence of critical engagement with relevant and current literature. Lack of use of appropriate sources and inconsistent and inaccurate referencing | Poorly presented and disorganised work that lacks a logical and coherent structure, lacks a well-formed central argument and shows a significant lack of clarity of expression with very weak or irrelevant conclusions, that may be incoherent to specialist or non-specialist audiences |

\* Work that significantly exceeds the specified word limit may be penalized